

## CARBON MONITORING AT THE ARM SOUTHERN GREAT PLAINS SITE

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### RESEARCH OBJECTIVES

Current challenges in carbon cycle research include bridging plot-scale measurements with regional- and global-scale models, and linking the fluxes of carbon, water, and energy from heterogeneous natural and managed ecosystems. To address these challenges, we are developing a carbon-monitoring program at DOE's Southern Great Plains (SGP) Atmospheric Radiation Measurement (ARM) Cloud and Radiation Testbed (CART) site. This site is ideal for carbon cycle research because of ARM's comprehensive atmospheric measurements, simple topography, and the region's mixture of land uses.

### APPROACH

We are performing the bulk of our work near the ARM Central Facility (CF) located in north-central Oklahoma. The land use in the region consists of crops (dominated by wheat), pasture, and native tallgrass prairie. To better understand the complex land-surface carbon exchange, we are building and deploying (1) three portable eddy covariance towers for CO<sub>2</sub> and energy fluxes, (2) a precise CO<sub>2</sub> measurement system at the CF 60 m tower, (3) an eddy covariance system at the CF 60 m tower, and (4) an isotope sample collection system for the CF and portable towers. Simultaneous measurements from the three 4.5 m portable towers will be used to characterize the heterogeneous ecosystem sources impacting concentrations and fluxes at the CF tower. We are also applying established models (SiB2 and LSM1.0) to simulate CO<sub>2</sub> and energy fluxes, and developing new methodologies to simulate H<sub>2</sub><sup>18</sup>O, C<sup>18</sup>OO, and <sup>13</sup>CO<sub>2</sub> fluxes. Improved understanding of <sup>13</sup>C and <sup>18</sup>O fluxes from ecosystems will allow us to more accurately partition net ecosystem exchange into respiration and photosynthetic uptake, thereby improving our ability to predict ecosystem behavior under changing environmental conditions.

### ACCOMPLISHMENTS

The portable eddy covariance system compared well in a cross-calibration test with a permanent Ameriflux site in Oklahoma (Figure 1). The permanent eddy covariance system was installed on the 60 m tower at the CF and is now continuously measuring fluxes over spatial scales that cover a mixture of land uses. We have tested the high-precision CO<sub>2</sub> system in the laboratory and installed it on the CF tower; in the tests, the system matched the NOAA standard to within 0.05 ppm. The land-surface model is accurately capturing the dynamics and magnitude of ecosystem carbon and energy exchanges at the tallgrass prairie site. We have also completed integration of submodels into LSM1.0 to simulate canopy vapor, leaf water, and vertically resolved soil water H<sub>2</sub><sup>18</sup>O content; leaf photosynthetic and retro-diffusive fluxes of C<sup>18</sup>OO; root and microbial

production of CO<sub>2</sub>; and soil CO<sub>2</sub> and C<sup>18</sup>OO diffusive fluxes and equilibration with soil water.

### SIGNIFICANCE OF FINDINGS

The good performance of the portable eddy covariance tower implies that we can effectively test the ecosystem model predictions over various land uses and meteorological conditions. During this year's summer field season, we intend to characterize the various ecosystems in the CF footprint and test the integrated flux measured at the 60 m

tower against the measured and modeled distributed source. This approach will allow us to integrate ecosystem sources and sinks from the heterogeneous landscape and predict regional-scale carbon fluxes.

### ACKNOWLEDGMENTS

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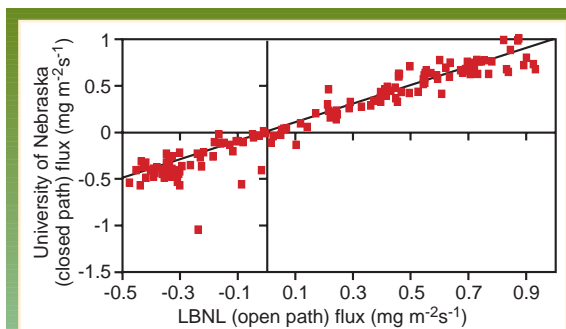


Figure 1. Cross calibration of Berkeley Lab-ARM system at the Ameriflux tallgrass prairie site in Oklahoma.